

REMARKS

Reconsideration is requested for claims 1-6, 9-25, 28-33, and 36-42. Favorable action is requested for claims 45-52. Claims 7-8, 26-27, 34-35, and 43-44 have been cancelled without prejudice or disclaimer.

Claim 28 was objected to on the basis of a minor informality. Claim 28 has been amended to address the objection.

Claims 1, 6, 7, 10, 13-24, 26, 28, 33, 34, and 38-43 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 4,953,191 to *Smither et al.* in view of U.S. Patent No. 6,002,744 to *Hertz et al.*

Claim 1, from which claims 2-6, 9-25, and 45-48 depend, as amended, defines a method for generating X-ray radiation, comprising the steps of forming a target jet by urging a liquid substance under pressure through an outlet opening, the target jet propagating through an area of interaction, directing at least one electron beam onto the target jet in the area of interaction such that the electron beam interacts with the target jet to generate X-ray radiation, and controlling the electron beam to interact with the jet at an intensity such that Bremsstrahlung and characteristic line emission is generated in the X-ray region wherein the target jet is formed to have a sufficiently high propagation speed in the area of interaction in order for the emission to be generated essentially without heating the jet to a plasma-forming temperature, the propagation speed being at least 10 m/s in the area of interaction.

The method of claim 1 offers various advantages. For example, because it is possible to provide a substantial amount of target material per unit time, the intensity of the electron beam can be increased further before problems associated with boiling or evaporation become too limiting and, therefore, the X-ray radiation can have a very high brightness. Also, the present invention permits excellent spatial access to the target jet for purposes of exciting the target and for purposes of collecting emitted X-ray radiation.

Smither et al. discloses an X-ray source in which a stream of liquid gallium is used as the anode for an electron gun. The stream of liquid gallium flows at a rate of, e.g., 200 cm/second (Col. 4, lines 27-29). Higher flow rates are suggested to result in turbulent flow. Col. 4, lines 33-46. No alternative to liquid gallium is disclosed. In view of the various limitations of *Smither et al.*, electron beam intensity must be limited.

Smither et al. does not disclose the combination of steps of claim 1. For example, *Smither et al.* does not disclose a combination of steps including forming a target jet by urging a liquid substance under pressure through an outlet opening, the target jet propagating through an area of interaction at a speed of at least 10 m/s. It would not have been obvious to provide this feature in a method using the equipment disclosed in *Smither et al.* because *Smither et al.* teaches away from higher propagation speeds because of the problems associated with higher flow rates mentioned above. It is respectfully submitted that *Hertz et al.* cures none of the defects of *Smither et al.*

In view of the differences between claim 1 and *Smither et al.* in view of *Hertz et al.*, it is respectfully submitted that claim 1 and the claims dependent therefrom, claims 2-25 and 45-48, define patentably over the cited references.

Claim 28, as amended, from which claims 29-42 and 49-52 depend, defines an apparatus for generating X-ray radiation, comprising a target generator arranged to form a target jet by urging a liquid substance through an outlet opening, the target jet propagating towards an area of interaction, an electron source for providing at least one electron beam and directing the at least one electron beam onto the jet in the area of interaction, the radiation being generated by the electron beam interacting with the jet, and wherein the electron source is controllable to effect interaction of the electron beam with the target jet at an intensity of the electron beam such that Bremsstrahlung and characteristic line emission is generated in the X-ray region, essentially without heating the jet to a plasma-forming temperature, and wherein the target generator is operative to generate the target jet to have a sufficiently high propagation speed in the area of interaction in order for the emission to be generated essentially without heating the jet to a plasma-forming temperature, the propagation speed being at least 10 m/s in the area of interaction.

The apparatus of claim 28 offers various advantages. For example, because it is possible to provide a substantial amount of target material per unit time, the intensity of the electron beam can be increased further before problems associated with boiling or evaporation become too limiting and, therefore, the X-ray radiation can have a very high

brightness. Also, the present invention permits excellent spatial access to the target jet for purposes of exciting the target and for purposes of collecting emitted X-ray radiation.

Smither et al. does not disclose the combination of features of claim 28. For example, *Smither et al.* does not disclose a combination of features including a target generator that generates a target jet that propagates at a propagation speed of at least 10 m/s in an area of interaction. *Smither et al.* teaches away from a target generator that generates a propagation speed higher than about 200 cm/s. *Hertz et al.* cures none of the defects of *Smither et al.*

Claim 25 was rejected under 35 U.S.C. § 103(a) as being unpatentable over *Smither et al.* in view of *Hertz et al.* and U.S. Patent No. 5,978,444 to *Atac et al.* It is respectfully submitted that *Atac et al.*, which was cited only as disclosing performing X-ray diffraction for the purpose of protein structure determination, does not cure the defects of *Smither et al.* and *Hertz et al.* as discussed above with respect to claim 1, from which claim 25 depends, and claim 1 and the claims dependent therefrom, including claim 25, defines patentably over *Smither et al.* in view of *Hertz et al.* and *Atac et al.*

Claims 8 and 35 were rejected under 35 U.S.C. § 103(a) as being unpatentable over *Smither et al.* in view of *Hertz et al.* and U.S. Patent No. 4,723,262 to *Noda et al.* Claims 8 and 35 have been cancelled without prejudice or disclaimer.

Claims 2-5, 9, 11, 12, 29-32, 36, and 37 were rejected under 35 U.S.C. § 103(a) as being unpatentable over *Smither et al.* in view of *Hertz et al.* and U.S. Patent No. 6,324,255 to *Kondo et al.* It is respectfully submitted that *Kondo et al.*, which was cited

only as disclosing the use of metal heated to a liquid state for use as a target, does not cure the defects of *Smither et al.* and *Hertz et al.* as discussed above with respect to claim 1, from which claims 2-5, 9, 11, and 12 depend, and claim 1 and the claims dependent therefrom, including claims 2-5, 9, 11, and 12, define patentably over *Smither et al.* in view of *Hertz et al.* and *Kondo et al.* Likewise, *Kondo et al.* does not cure the defects of *Smither et al.* and *Hertz et al.* as discussed above with respect to claim 28, from which claims 29-32, 36, and 37 depend, and claim 28 and the claims dependent therefrom, including claims 29-32, 36, and 37, define patentably over *Smither et al.* in view of *Hertz et al.* and *Kondo et al.*

Claims 27 and 44 were rejected under 35 U.S.C. § 103(a) as being unpatentable over *Noda et al.* in view of *Hertz et al.* Claims 27 and 44 have been cancelled without prejudice or disclaimer.

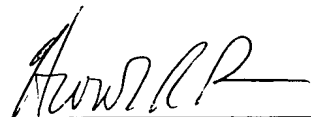
It is respectfully submitted that all of the pending claims, claims 1-6, 9-25, 28-33, 36-42, and 45-52, are in condition for allowance. Allowance is cordially urged.

If the Examiner should be of the opinion that a telephone conference would be helpful in resolving any issues, the Examiner is urged to contact the undersigned.

Respectfully submitted,

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